

EXECUTIVE SUMMARY

This *Final Constellation Programmatic Environmental Impact Statement* has been prepared by the National Aeronautics and Space Administration (NASA) to assist in the decision-making process as required by the National Environmental Policy Act of 1969, as amended (NEPA) (42 United States Code [U.S.C.] 4321 *et seq.*); Council on Environmental Quality regulations for implementing the procedural provisions of NEPA (40 Code of Federal Regulations [CFR] parts 1500-1508); NASA policies and procedures at 14 CFR subpart 1216.3; and Executive Order (EO) 12114, *Environmental Effects Abroad of Major Federal Actions*.

CONSTELLATION PROGRAMMATIC ENVIRONMENTAL IMPACT STATEMENT ROADMAP

Chapter 1: Purpose and Need for Action

- Describes the purpose and need for the Constellation Program

Chapter 2: Description and Comparison of Alternatives

- Describes the Proposed Action (Preferred Alternative), the Constellation Program and its constituent Projects
- Describes the No Action Alternative
- Briefly describes alternatives considered but eliminated from further evaluation
- Summarizes and contrasts the environmental impacts of the Proposed Action and the No Action Alternative

Chapter 3: Description of the Affected Environment

- Describes the existing environmental resources (*e.g.*, land, air, and water) at the primary NASA, other government, and commercial facilities where potentially significant impacts from implementing the Constellation Program work could occur.
- Describes the global environment

Chapter 4: Environment Consequences of Alternatives

- Describes environmental impacts of implementing the Proposed Action and the No Action Alternative relevant to each environmental resource
- Identifies incomplete and unavailable information
- Lists Federal, state, or local permits, licenses, or consultations required for implementing the Proposed Action

Chapter 5: Mitigation Measures

- Describes mitigation measures to reduce or avoid potential environmental impacts

ES.1 BACKGROUND

In 2004, President George W. Bush announced a new exploration initiative (the *Vision for Space Exploration*) to return humans to the Moon by 2020 in preparation for human exploration of Mars and beyond. As part of this initiative, NASA will continue to use the Space Shuttle fleet to fulfill its obligation to complete assembly of the International Space Station and then retire the fleet by 2010. As the first step toward developing the vehicles to explore the Moon, Mars, and beyond, the President directed NASA to build and fly a new Crew Exploration Vehicle (CEV [since named Orion]) by 2014. The Orion spacecraft would be capable of transporting humans to the International Space Station, the Moon, and would be used on future missions to Mars and beyond.

Congress expressly endorsed the President's exploration initiative and provided additional direction for the initiative in the NASA Authorization Act of 2005, authorizing NASA to "...establish a program to develop a sustained human presence on the Moon, including a robust precursor program to promote exploration, science, commerce and U.S. preeminence in space, and as a stepping stone to future exploration of Mars and other destinations" (Pub. L. 109-155).

In response to the President's exploration initiative, NASA Administrator Michael Griffin commissioned the Exploration Systems Architecture Study (ESAS) to perform four specific tasks:

1. Complete assessment of the top-level CEV requirements and plans to enable the CEV to provide crew transport to the International Space Station and to accelerate the development of the CEV and crew launch system to reduce the gap between Space Shuttle retirement and CEV initial operational capability
2. Provide definition of top-level requirements and configurations for crew and cargo launch systems to support the lunar and Mars exploration programs
3. Develop a reference lunar exploration architecture concept to support sustained human and robotic lunar exploration operations
4. Identify key technologies required to enable and significantly enhance these reference exploration systems and reprioritize near- and far-term technology investments.

The ESAS Team examined multiple combinations of launch elements for crew and cargo missions, including launch vehicles derived from the Space Shuttle and from current and proposed U.S. heavy-lift launch vehicles (*e.g.*, Delta IV and Atlas V launch vehicles). The ESAS Team also developed new architecture-level requirements and an overall approach to meet the human exploration goals of the exploration initiative.

In order to meet the goals of the exploration initiative and to accomplish the specific directives given to NASA by the President and Congress, NASA initiated and is in the early planning stages of the proposed Constellation Program. The Constellation Program used the ESAS Team's recommendations and the underlying Presidential and Congressional directives as a starting point and has continued to refine the mission requirements, evaluate capabilities for the technologies studied by the ESAS Team, and perform more detailed examination of the developmental requirements. The Constellation Program would develop the flight systems and Earth-based ground infrastructure necessary to enable continued human access to space.

As envisioned by NASA, an incremental buildup would begin with up to four person crews making several short-duration trips of up to 14 days to the Moon until power supplies, rovers, and living quarters would become operational. These would be followed by long-duration human lunar missions increasing up to 180 days.

ES.2 PURPOSE AND NEED OF THE ACTION

The 2004 announcement by President Bush set the long-term goals and objectives for the Nation's space exploration efforts. The underlying goals, and hence the need for NASA action,

are to advance the Nation's scientific, security, and economic interests through a robust space exploration program. In achieving this goal, the U.S. will pursue the following initiatives:

- Implement a sustained and affordable human and robotic program to explore the Solar System and beyond
- Extend human presence across the Solar System, starting with a return of humans to the Moon by 2020 in preparation for human exploration of Mars and other Solar System destinations
- Develop innovative technologies, knowledge, and infrastructure both to explore and to support decisions about the destinations for human exploration
- Promote international and commercial participation in this new space exploration program.

As the lead agency, NASA was tasked with development of the plans, programs, and activities required to implement the Nation's space exploration efforts. The following directives were among those given to NASA in the NASA Authorization Act of 2005 and/or the President's announcement of the *Vision for Space Exploration*:

- Develop a crew exploration vehicle to replace the Space Shuttle fleet by 2014, and as close to 2010 as possible
- To the fullest extent possible consistent with a successful development program, use the personnel, capabilities, assets, and infrastructure of the Space Shuttle Program in developing the Crew Exploration Vehicle, Crew Launch Vehicle, and a heavy-lift launch vehicle
- Undertake lunar exploration activities directed at enabling robotic and human exploration of Mars and beyond
- Conduct the first extended human exploration mission to the lunar surface by the end of the next decade
- Use the knowledge gained from successful sustained human exploration of the Moon and robotic exploration of Mars, conduct human exploration expeditions to Mars and, ultimately, other destinations in our Solar System.

The purpose of NASA's Proposed Action (Preferred Alternative) is to undertake the activities necessary to pursue the human exploration elements of these directives, including developing the flight systems and ground infrastructure required to enable continued access to space and to enable future crewed missions to the International Space Station, the Moon, Mars, and beyond. Robotic exploration activities are the responsibility of other NASA programs and are subject to separate NEPA review and documentation, as appropriate.

NASA's current human space flight system, the Space Shuttle, is not suited for human travel beyond low Earth orbit. To fulfill the purpose outlined in the President's exploration initiative, and to accomplish the specific directives given to NASA by the President and Congress, NASA proposes to continue preparations for and to implement the Constellation Program and develop a new class of exploration vehicles and the infrastructure necessary to support their development and use in space exploration.

The vehicles to be developed include the Orion spacecraft (see Figure ES-1) and two launch vehicles, the Crew Launch Vehicle (CLV [since named Ares I]) (see Figure ES-2) and a Cargo Launch Vehicle (CaLV [since named Ares V]) (see Figure ES-3). The Orion spacecraft, launched atop the Ares I, would be capable of docking with the International Space Station or docking with cargo launched to low Earth orbit by the Ares V for transit to the Moon or future missions to Mars.

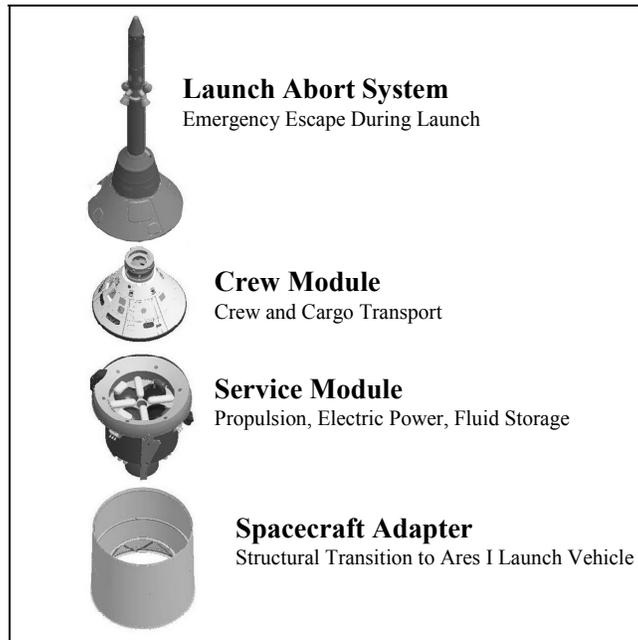


Figure ES-1. Orion Spacecraft Modules

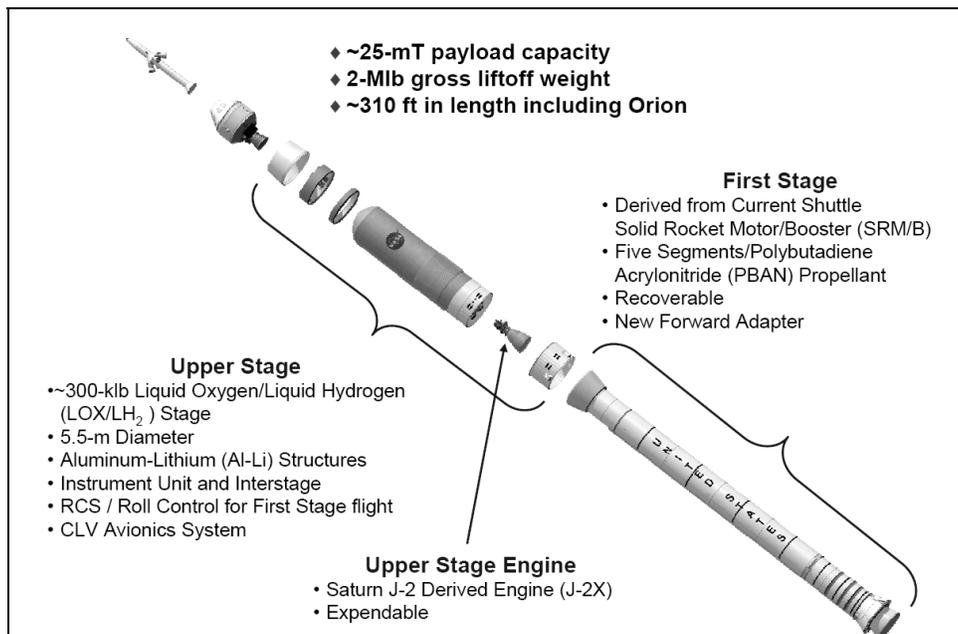


Figure ES-2. Ares I Launch Vehicle

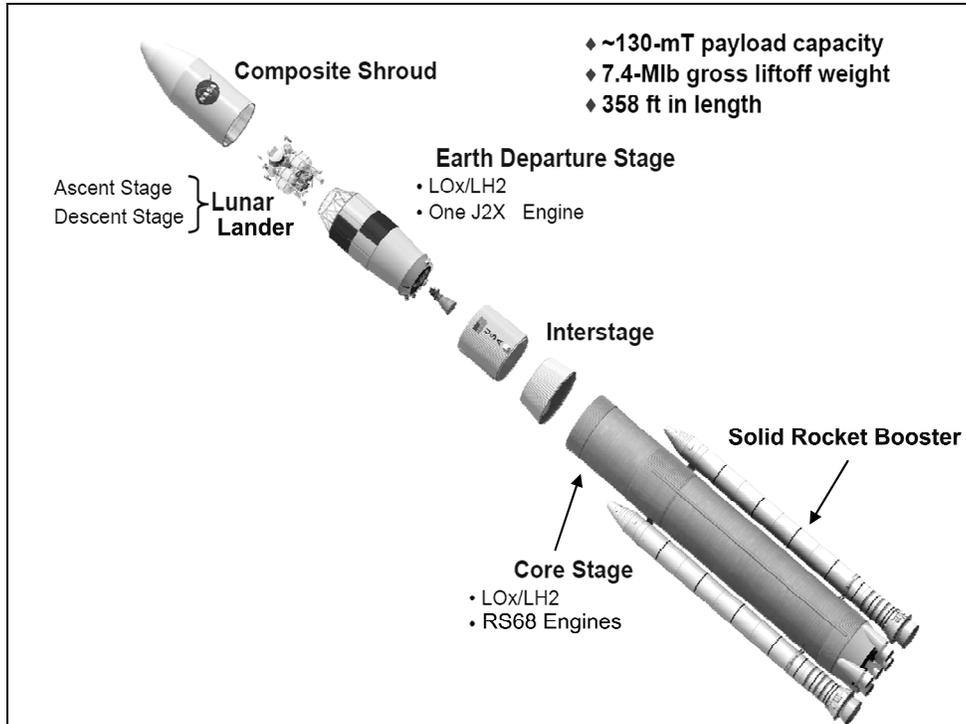


Figure ES-3. Ares V Launch Vehicle

Beyond meeting the needs of future human space flight, the Constellation Program would greatly enhance NASA's ability to meet other broad goals set for the U.S. Space Program. Historically, the U.S. Space Program has produced technological advances that have tangible, global benefits. For example, advances in weather forecasting, communications, computing, search and rescue technology, robotics, and electronics are direct results of the U.S. Space Program. Medical technologies, such as computer-aided tomography (CAT) scanners and magnetic resonance imaging (MRI) machines, are also derived from technologies developed for the use in space. These benefits have come directly from activities at NASA and from activities inspired by the discoveries and advancements made through NASA programs. The Constellation Program would continue to provide the opportunity for such advancements by contributing to:

- The extension of human presence beyond Earth orbit
- The pursuit of scientific activities that address fundamental questions about the history of Earth, the Solar System, and the Universe
- A challenging, shared peaceful experience that unites nations in pursuit of common objectives
- The expansion of Earth's economic sphere and conducting activities with benefits to life on Earth
- A vibrant space exploration program to engage the public, encourage students, and help develop the high-tech workforce that will be required to address the challenges of tomorrow.

As directed by the President, retirement of the Space Shuttle fleet is expected to occur by 2010 and is a separate action from the Constellation Program. The environmental impacts associated with retiring the Space Shuttle fleet will be addressed in the *Draft Programmatic Environmental Assessment for Space Shuttle Program Transition and Retirement*, which is scheduled to be released by NASA for public review and comment in early 2008.

ES.3 NEPA ACTIVITIES FOR THE CONSTELLATION PROGRAM

ES.3.1 NEPA Planning and Scoping Activities

On September 26, 2006, NASA published a Notice of Intent (NOI) in the *Federal Register (FR)* (71 *FR* 56183) to prepare a Draft Programmatic Environmental Impact Statement (PEIS) and conduct scoping for the Constellation Program. Scoping meetings to solicit public input on environmental concerns and alternatives to be considered in the PEIS were held on October 18, 2006 in Cocoa, Florida; on October 20, 2006 in Washington, DC; and on October 24, 2006 in Salt Lake City, Utah. Comments were solicited from Federal, state, and local agencies and other interested parties on the scope of the Constellation Program. Scoping comments were received from private organizations and individuals in the form of letters, electronic mail, telephone messages, and oral and written comments provided at the public scoping meetings. The scoping period ended on November 13, 2006. The scoping comments expressed concerns or questions about both technological and environmental issues.

The following issues were identified through the public scoping process and are addressed briefly in Section ES.7 and in detail in Chapter 4 of this Final PEIS:

- The economic impact of the Constellation Program, locally and nationally, with an emphasis on the impact of the Program on jobs near NASA Centers
- Risks to the public associated with launch and Earth atmospheric entry
- Environmental impacts of the use of solid rocket fuels on the ozone layer and impacts associated with the deposition of combustion products near the launch area
- Impacts on local animal species (*e.g.*, sea turtles and manatees) associated with construction and launch activities in the John F. Kennedy Space Center (KSC) area
- Noise impacts associated with launch events
- The relationship between the Constellation Program and the Space Shuttle Program, including how the socioeconomic impacts of the Space Shuttle retirement and the Constellation Program overlap.

Additional technology-related issues that were identified and are addressed in detail in Chapter 2, Section 2.3 of this Final PEIS include:

- Alternative technologies to be used for the launch vehicles, including the possibility of using Evolved Expendable Launch Vehicles (*i.e.*, Atlas V and Delta IV launch vehicles) developed by the U.S. Air Force (USAF) instead of developing new launch vehicles
- Involvement of entities other than NASA in the development of the launch systems, in particular potential international partnerships and partnerships with private industry.

Issues raised that are outside the scope of this Final PEIS include the following:

- Possible military applications associated with the Constellation Program
- Legal issues associated with the use of the Moon and its raw materials
- Environmental impacts in outer space, including impacts on the Moon
- Use of nuclear systems in support of the Constellation Program (Future program activities may benefit from use of nuclear systems in areas such as planetary electrical power generation or interplanetary propulsion. Technical studies will be conducted to determine whether nuclear-based systems can safely and affordably enhance future mission capabilities. Any future activities associated with development and use of nuclear systems for the Constellation Program would be subject to separate NEPA review and documentation, as appropriate)
- Maintaining funding for the Constellation Program for the extended period required to meet the Program's goals
- The possible gap in the ability of the U.S. to provide crew transport to the International Space Station
- Supply of crew and/or cargo to the International Space Station by commercial entities (which would be subject to separate NEPA review and documentation, as appropriate, by NASA independently or in connection with the Federal Aviation Administration commercial licensing process).

An additional issue that was raised which is relevant to the Constellation Program, but not addressed fully in this Final PEIS, involves traffic impacts (*e.g.*, congestion and emissions) associated with landing events at a terrestrial landing site. Impacts associated with terrestrial landing sites would be addressed in separate NEPA documentation, as appropriate.

ES.3.2 Results of Public Review of the Draft PEIS

NASA published a Notice of Availability (NOA) of the *Draft Constellation Programmatic Environmental Impact Statement* on August 17, 2007 (72 FR 46218). NASA mailed over 300 hard copies and/or compact disks (CDs) of the Draft PEIS to potentially interested Federal, state, and local agencies; organizations; and individuals. In addition, the Draft PEIS was made publicly available in electronic format on NASA's web site. NASA also sent electronic mail (e-mail) notifications to potentially interested individuals who had submitted scoping comments via e-mail but who had not provided a mailing address.

The public review and comment period for the Draft PEIS closed on September 30, 2007. NASA received a total of 21 submissions (letters and e-mails) from Federal, state, and local agencies; organizations; and individuals, of which, 14 submissions contained comments regarding the Constellation Program. Seven submissions only requested to be added to the mailing list to receive a copy of the Final PEIS. The comment submissions included concerns regarding:

- Establishing a light management plan at KSC
- Establishing a monitoring program for bird strikes at KSC

- Water quality, air quality, and hazardous wastes at the U.S. Army's White Sands Missile Range (WSMR)
- Performing a coastal zone consistency determination for Langley Research Center (LaRC)
- Raising awareness of metals in the environment
- Environmental impacts in outer space, including impacts on the Moon.

All comment submissions received by NASA during the Draft PEIS public review period can be found in Appendix B of this Final PEIS, along with NASA's responses to specific comments. No alternatives to the Proposed Action were raised during the public review of the Draft PEIS.

ES.4 ALTERNATIVES EVALUATED

Two alternatives are evaluated in this Final PEIS: 1) the Proposed Action (Preferred Alternative) – to continue preparations for and to implement the Constellation Program; and 2) the No Action Alternative – do not continue preparations for nor implement the Constellation Program.

NASA also considered alternatives to the Proposed Action that were not evaluated further. These included modifying the Space Shuttle fleet, purchasing space transportation services for human exploration of space from foreign governments, varied designs and configurations for the CEV (*i.e.*, Orion) spacecraft, and multiple launch vehicle options for both crew and cargo launches. These alternatives were eliminated from further evaluation based on various considerations, including safety, technical feasibility, cost, development time and risk, and consistency with Presidential and Congressional directives.

ES.4.1 Proposed Action (Preferred Alternative)

NASA proposes to continue preparations for and to implement the Constellation Program, using the ESAS and the underlying Presidential and Congressional directives as a starting point. The focus of the Constellation Program is the development of the flight systems and Earth-based ground infrastructure required to enable continued access to space and to enable future crewed missions to the International Space Station, the Moon, Mars, and beyond. The Constellation Program also would be responsible for the development and testing of flight hardware and for performing mission operations once the infrastructure is sufficiently developed.

The Constellation Program would be an extremely large and complex program spanning decades and requiring the efforts of a broad spectrum of talent located throughout NASA and in private industry. Figure ES-4 provides a high-level schedule for the Constellation Program, shown in conjunction with related NASA initiatives. The Constellation Program would first undertake developing the infrastructure and systems necessary to support the International Space Station and return humans to the Moon. This initial effort would then be directed towards developing the capability to extend human exploration to Mars and beyond. The first crewed missions using the Orion spacecraft and the Ares I launch vehicle are proposed by 2014, and would provide crew transport to the International Space Station. Once operational, up to five flights per year are anticipated until the end of International Space Station operations (U.S. commitment to International Space Station operations extends well into the next decade). The first human mission to the Moon is proposed by 2020.

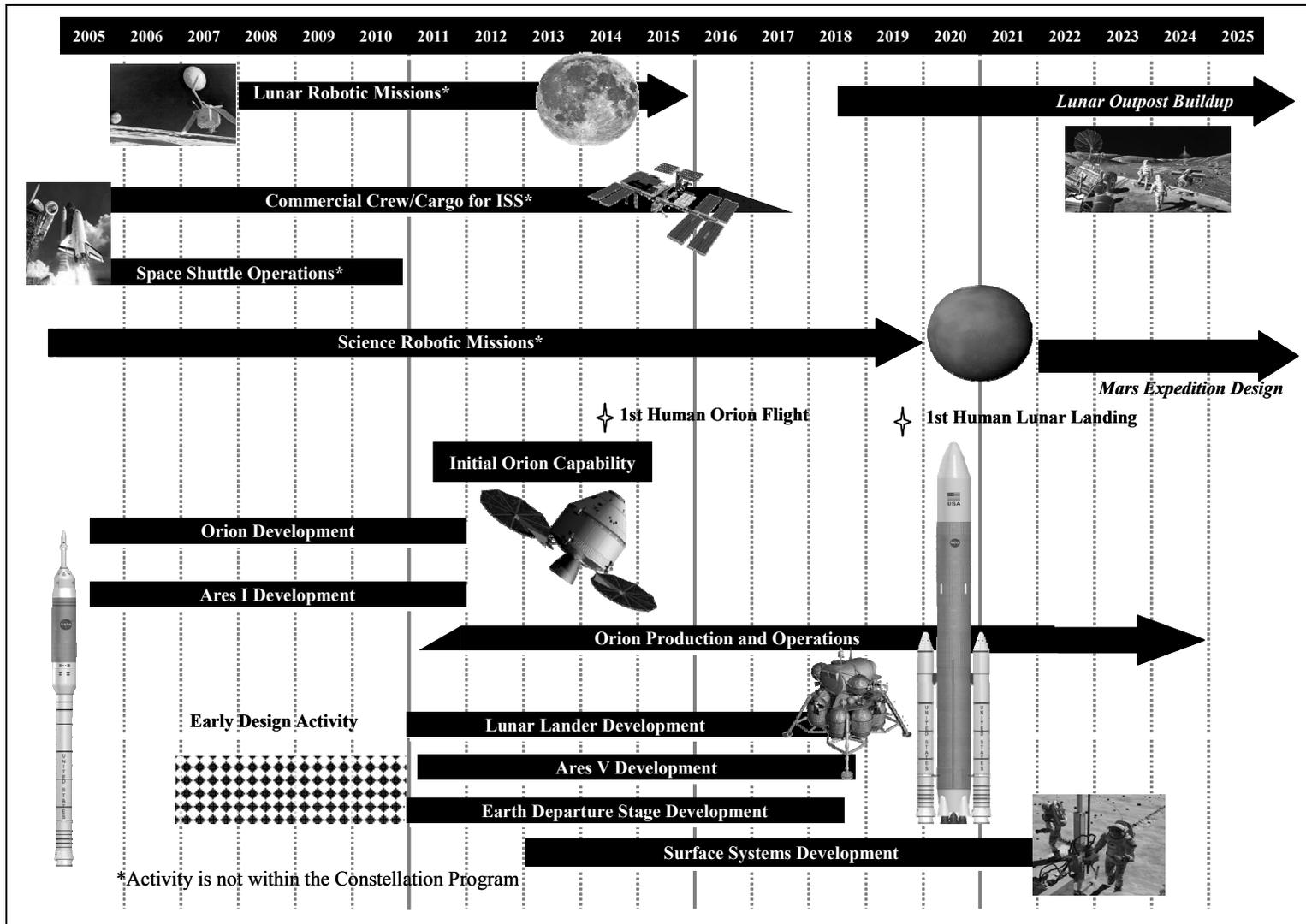


Figure ES-4. NASA's Exploration Roadmap with the Constellation Program Through 2025

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The first missions to the Moon would be short-duration stays of up to 14 days. Once sufficient infrastructure is built, they would evolve into longer-duration missions, culminating in a permanently occupied lunar outpost. Expeditions to a lunar outpost would last up to 180 days. In addition to the lunar exploration capabilities associated with the outpost, these missions would provide the opportunity to test equipment and procedures that could be used on future human missions to Mars.

Organizationally, the Constellation Program would consist of a single Program Office at NASA’s Lyndon B. Johnson Space Center (JSC) in Houston, Texas that would have overall responsibility for management of the Constellation Program, and multiple Project Offices. Each Project Office would focus on specific technology and systems development and operational capabilities for the Constellation Program (see Table ES-1).

Table ES-1. Summary of Constellation Projects

Constellation Project	Lead NASA Center	Function	
		Developmental Phase	Operational Phase
Project Orion	JSC	Develop and test the Orion spacecraft to transport crew and cargo to and from space.	Provide Orion spacecraft.
Project Ares	MSFC	Develop and test the Ares I and Ares V launch vehicles.	Provide Ares launch vehicles.
Ground Operations Project	KSC	Perform ground processing and integrated testing of the launch vehicles. Provide logistics and launch services. Provide post-landing and recovery services for the crew (if any), Orion Crew Module, and spent Ares I First Stage and Ares V solid rocket boosters.	Provide ground processing, logistics, and launch services. Provide post-landing and recovery services for the crew, Orion Crew Module, and spent Ares I First Stage and Ares V solid rocket boosters.
Mission Operations Project	JSC	Configure, test, plan, and operate facilities, systems, and procedures. Plan missions and flight operations.	Train crew, flight controllers, and support staff. Coordinate crew operations during missions.
Lunar Lander Project	JSC	Develop and test the Lunar Lander to transport crew and cargo to and from the lunar surface and to provide a habitat for initial lunar missions.	Provide Lunar Lander.
Extravehicular Activities Systems Project	JSC	Develop and test EVA systems (spacesuits, tools, and servicing and support equipment) to support crew survival during launch, atmospheric entry, landing, abort scenarios, and outside the space vehicle and on the lunar surface.	Provide spacesuits and tools.
Possible Future Projects	To be determined	Develop systems for future applications including Lunar Surface Systems (this consists of a wide array of research and development activities associated with equipment and systems needed to operate on the lunar surface) and systems for future Mars exploration activities (e.g., Mars transportation and surface systems).	Provide future systems as needed.

Note: Range Safety for the Constellation Program is managed by JSC.

Project Orion, led by JSC, would focus on production, assembly, and ground and flight testing the Orion spacecraft. The initial design, fabrication, and assembly of a limited number of Orion spacecraft has been addressed in the *Final Environmental Assessment for the Development of the Crew Exploration Vehicle*. NASA published a Finding of No Significant Impact (FONSI) in the *Federal Register* on September 1, 2006 (71 FR 52169), which allowed for the proposed action to proceed.

Project Ares, led by George C. Marshall Space Flight Center (MSFC) would be responsible for design, development, and testing of two new launch vehicles; the Ares I and the Ares V.

To support launch operations, the Ground Operations Project, led by KSC, would develop ground infrastructure for vehicle processing (*i.e.*, final assembly and testing) and launch (*i.e.*, ground servicing equipment, launch pads, and launch control) needed for both Orion and Ares. NASA has begun modifying Launch Complex (LC)-39 Pad B at KSC to launch initial Ares missions. This action was addressed in the *Final Environmental Assessment for the Construction, Modification, and Operation of Three Facilities in Support of the Constellation Program, John F. Kennedy Space Center, Florida*. NASA signed a FONSI on May 2, 2007, which authorized the proposed action to proceed. Similar modifications would be made to LC-39 Pad A at a later time, which are incorporated by reference in this Final PEIS. The Ground Operations Project also would use systems developed for the Space Shuttle to recover the Ares I First Stage, the Ares V Solid Rocket Boosters (SRBs), while new systems would be developed for recovery of the Orion Crew Module upon its return to Earth. The Constellation Program is studying the possibility of not recovering the spent Ares I First Stage and Ares V SRBs for certain missions. This could gain additional performance margin for certain missions by eliminating the launch weight of the booster recovery systems.

The Mission Operations Project, led by JSC, would develop the processes needed to prepare for missions (primarily training programs and mission plans) and manage the Earth-based infrastructure needed to execute the missions (*e.g.*, the Mission Control Center at JSC). The Lunar Lander Project, led by JSC, would be responsible for the design, development, and testing of the Lunar Lander. The Extravehicular Activities (EVA) Project, led by JSC, would primarily be responsible for developing spacesuits, tools, and equipment necessary to work outside the protective confinements of a spacecraft. Future mission requirements (*e.g.*, Lunar Surface Systems and Mars Systems) would be developed within an Advanced Projects Office. Additional projects would be established once these requirements mature sufficiently.

In support of missions, Project Orion would build and deliver the Orion spacecraft to the Ground Operations Project at KSC for final assembly and integration with the Ares I launch vehicle. Project Ares would construct the components for the Ares I launch vehicle and deliver them to the Ground Operations Project at KSC, where final assembly of the launch vehicle would occur. The Lunar Lander and crew spacesuits and tools would be provided by the Lunar Lander Project and the EVA Systems Project respectively.

The Ground Operations Project would be responsible for final assembly and integration of the Orion spacecraft and Ares launch vehicles and for launch pad preparations and launch in coordination with Launch Range Safety at KSC/Cape Canaveral Air Force Station (CCAFS). The Mission Operations Project would be responsible for planning the mission and training the

crew and ground personnel needed to perform the mission, and once the mission is launched, the Mission Operations Project would have responsibility for performing the mission and coordinating all crew and ground personnel activities during the mission (e.g., docking, lunar landing and surface activities, and return to Earth). The Ground Operations Project would be responsible for recovery of the crew and all reusable flight hardware (Crew Module, Ares I First Stage, and Ares V SRBs).

Although the Constellation Program and the six Projects would be led from three NASA Centers (JSC, KSC, and MSFC) as currently defined, the Constellation Program would utilize personnel and facilities throughout NASA, in addition to other U.S. Government and commercial personnel and facilities. Figure ES-5 provides the locations of the primary U.S. Government facilities, along with commercial facilities where potential significant environmental impacts from implementing the Constellation Program could occur.

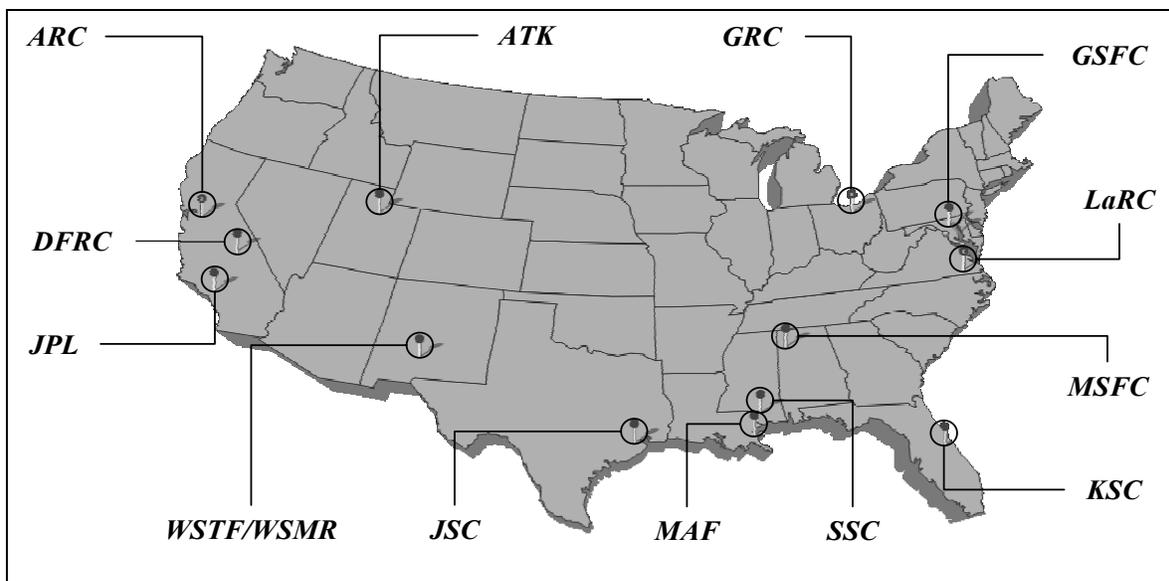


Figure ES-5. Principal U.S. Government and Commercial Facilities Contributing to the Constellation Program

These include KSC, John C. Stennis Space Center (SSC), Michoud Assembly Facility (MAF), JSC, MSFC, John H. Glenn Research Center (GRC) at Lewis Field and at Plum Brook Station (PBS), LaRC, Ames Research Center (ARC), WSMR/Johnson Space Center White Sands Test Facility (WSTF), Dryden Flight Research Center (DFRC), Goddard Space Flight Center (GSFC), Jet Propulsion Laboratory (JPL), and Alliant Techsystems-Launch Systems Group (ATK) facilities at Clearfield and Promontory, Utah.

It is expected that much of the construction and assembly of the Orion spacecraft would occur at MAF, KSC, and contractor facilities. Construction of the Ares launch vehicles would be expected to be performed at contractor and U.S. government facilities with final assembly at KSC. Development of the Orion spacecraft and the Ares launch vehicles would include a wide variety of test activities. Engine and solid rocket motor tests would be expected to be performed at both U.S. Government and contractor facilities (e.g., SSC, MSFC, WSTF, and ATK) and would include

vehicle test launches at KSC. Vacuum chamber and wind tunnel testing would primarily occur at NASA Centers although other U.S. Government and commercial facilities may also be used.

NASA prepared this PEIS early in the development of the proposed Constellation Program. As such, it remains undetermined what contractors and contractor facilities may be involved in many aspects of the fully implemented Constellation Program. However, as with previous NASA programs, contractors likely would play a major role in most aspects of the Constellation Program, and contractor work would likely be performed at both contractor-owned and government-owned facilities. This PEIS was drafted to provide a public discussion of the Constellation Program's environmental impacts that is as comprehensive as possible and, as a result, includes some discussion of the potential environmental impacts of contractor work that would not be fully defined until procurement actions related to the Constellation Program are finalized. These discussions of anticipated environmental impacts are based on experience with previous NASA programs and on the best available information at the time of preparing this PEIS, and are provided solely to inform the public about anticipated or potential environmental impacts of the Constellation Program. Such discussions do not impact future procurement activities or indicate NASA's intentions concerning such activities.

ES.4.2 No Action Alternative

Under the No Action Alternative, NASA would not continue preparation for nor implement the Constellation Program. NASA would forego the opportunity for human missions to the Moon, Mars, and beyond using U.S. space vehicles. The U.S. would continue to rely upon robotic missions for space exploration activities. The opportunity for U.S. commercial entities to provide crew and cargo service to the International Space Station would be unaffected by the decision not to implement the Constellation Program. Other than the potential for commercial crew and cargo service to the International Space Station, the U.S. would depend upon foreign partners to deliver crew and cargo to and from the International Space Station.

ES.5 RELATED NEPA ACTIVITIES

In order to meet the timeline established by the President and Congress for the exploration initiative, NASA needed to begin work on several activities (*e.g.*, facility modifications and vehicle design, construction, and testing) in advance of rendering a record of decision (ROD) for this Final PEIS, anticipated in early-2008. Therefore, NASA prepared the following separate NEPA documentation to analyze the potential environmental impacts of such activities prior to final planning and implementation. These NEPA documents are incorporated by reference in this Final PEIS:

- *Final Environmental Assessment for the Development of the Crew Exploration Vehicle.* NASA's FONSI was published in the *Federal Register* on September 1, 2006 (71 FR 52169).
- *Final Environmental Assessment for the Construction, Modification, and Operation of Three Facilities in Support of the Constellation Program, John F. Kennedy Space Center, Florida.* A FONSI was signed by NASA on May 2, 2007.

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- *Final Environmental Assessment for the Construction and Operation of the Constellation Program A-3 Test Stand, Stennis Space Center, Hancock County, Mississippi.* A FONSI was signed by NASA on June 4, 2007.
- *Final Environmental Assessment for NASA Launch Abort System (LAS) Test Program, NASA Johnson Space Center White Sands Test Facility, Las Cruces, New Mexico.* A FONSI was signed by NASA on August 5, 2007.
- *Final Environmental Assessment for Modification and Operation of TS 4550 in support of Ground Vibration Testing for the Constellation Program.* A FONSI is expected to be signed by NASA in early 2008.

The Constellation Program is considering the use of both water (ocean) and terrestrial landing sites for crew return. The selection of potential terrestrial landing sites is ongoing and some of the information necessary to identify and analyze the potential terrestrial landing sites was not available before this Final PEIS was completed. Therefore, this Final PEIS includes only a general discussion of the environmental impacts associated with terrestrial landings. NASA intends to address the selection and operation of terrestrial landing sites in separate NEPA documentation, as appropriate. The environmental impacts associated with a water landing are addressed in this Final PEIS.

This Final PEIS is intended to address the potential environmental impacts associated with Constellation Program activities through the early 2020s. Under the present schedule, this includes the proposed development of the Ares launch vehicles and Orion spacecraft, development of advanced systems needed to successfully complete missions (e.g., Lunar Lander, Lunar Surface Systems, spacesuits [also used for missions to low Earth orbit], and tools), development and construction of infrastructure needed to support ground and mission operations, early missions to support the International Space Station, and short-duration missions to the Moon. The U.S. commitment to the International Space Station extends well into the next decade, with up to five proposed Orion/Ares I launches per year. The current Constellation Program baseline plan includes up to four lunar missions through 2020.

While significant detail is provided on the current planning configuration of the Ares V, the ultimate vehicle requirements and configuration would be dictated by the performance necessary to support the Lunar Lander, Lunar Surface Systems, and Mars missions. If significant changes to the Ares V planning configuration reflected in this Final PEIS occur, they would be subject to separate NEPA review and documentation, as appropriate.

There are potential future activities associated with the Constellation Program that are beyond the scope of this Final PEIS. Missions to establish a permanent lunar outpost and crewed missions to Mars are activities that are currently not expected to occur during the timeframe addressed in this Final PEIS. Development, operation, and mission activities associated with these actions would be subject to separate NEPA review and documentation, as appropriate. Future program activities may benefit from use of nuclear systems in areas such as planetary electrical power generation or interplanetary propulsion. Technical studies will be conducted to determine whether nuclear-based systems can safely and affordably enhance future mission capabilities. Any future activities associated with development and use of nuclear systems for

the Constellation Program would be subject to separate NEPA review and documentation, as appropriate.

ES.6 AFFECTED ENVIRONMENT

NASA would use multiple U.S. Government and commercial facilities in implementing the proposed Constellation Program. The activities proposed for the Constellation Program at these facilities would be expected to be within the scope of activities normally undertaken at each facility. Any activities determined to be outside the scope of activities normally undertaken at these facilities or at facilities which are not addressed in this Final PEIS would be subject to separate NEPA review and documentation, as appropriate.

ES.6.1 U.S. Government Facilities

ES.6.1.1 John F. Kennedy Space Center

NASA's KSC is located on the east coast of Florida adjacent to CCAFS. KSC is composed of 56,000 hectares (ha) (139,490 acres [ac]) of land and open water resources in Brevard and Volusia Counties. The primary mission of KSC is to process and launch the Space Shuttle and future generations of crewed space vehicles and to process payloads for various expendable launch vehicles launched from CCAFS. Launches from KSC are coordinated with Launch Range Safety at CCAFS. For the Constellation Program, KSC would manage the Ground Operations Project, including pre- and post-launch ground processing, launch support, and landing and recovery planning and execution.

ES.6.1.2 John C. Stennis Space Center

NASA's SSC is located along the northern edge of the Gulf of Mexico in western Hancock County, Mississippi. SSC encompasses approximately 5,585 ha (13,800 ac) of land that is surrounded by a 9.7-kilometer (km) (6-mile [mi]) buffer area to provide an acoustical and safety protection zone for NASA testing operations. SSC is responsible for testing and flight-certifying large rocket propulsion systems for the Space Shuttle and future generations of space vehicles. For the Constellation Program, SSC would be responsible for liquid hydrogen/liquid oxygen propulsion engine testing and verification for the Ares Upper Stage and the Ares V Core Stage.

ES.6.1.3 Michoud Assembly Facility

MAF is a Government-owned, contractor-operated component of MSFC located on approximately 337 ha (833 ac) in southeastern Louisiana. MAF is within the boundaries of Orleans Parish in the eastern section of metropolitan New Orleans. MAF's primary activities involve the manufacturing of the Space Shuttle External Tank. For the Constellation Program, MAF would manufacture, assemble, and test components of the Orion Crew Module and Service Module and the Ares I Upper Stage. In addition, MAF could possibly manufacture and assemble the Ares V Core Stage and/or the Earth Departure Stage.

ES.6.1.4 Lyndon B. Johnson Space Center

NASA's JSC is southeast of central Houston in Harris County, Texas. JSC encompasses approximately 640 ha (1,581 ac) of land and is devoted to research, development, and mission planning and control activities related to NASA's human space activities and operations. JSC would have lead responsibility for managing the Constellation Program, as well as Project Orion, the Mission Operations Project, the Lunar Lander Project, the Extravehicular Activities Systems Project and the Advanced Projects Office. JSC also operates two satellite facilities, Ellington Field and Sonny Carter Training Facility, located 13 km (8 mi) and 8 km (5 mi) northwest of JSC, respectively. Ellington Field is the center of aviation-related training operations for NASA's manned space program and the Sonny Carter Training Facility is utilized for astronaut training operations.

ES.6.1.5 George C. Marshall Space Flight Center

NASA's MSFC is located on approximately 745 ha (1,841 ac) within the grounds of the U.S. Army's Redstone Arsenal, southwest of Huntsville, Alabama. Redstone Arsenal occupies 15,503 ha (38,309 ac) in the southwestern portion of Madison County, Alabama. MSFC is almost centrally located within Redstone Arsenal, which provides a 4- to 11.3-km (2.5- to 7-mi) buffer between MSFC's engine test stands and the general public. MSFC is NASA's principal propulsion research center. For the Constellation Program, MSFC would manage Project Ares.

ES.6.1.6 John H. Glenn Research Center

NASA's GRC consists of two sites in Ohio: Lewis Field in western Cuyahoga County (near Cleveland) and Plum Brook Station (PBS) in west central Erie County, approximately 80 km (50 mi) west of Lewis Field. Lewis Field encompasses approximately 142 ha (350 ac) of highly developed and urbanized land within the city of Brook Park. PBS encompasses 2,614 ha (6,454 ac) of rural land, located south of Sandusky, Ohio. GRC specializes in power, propulsion, communications, and micro-gravity science research. For the Constellation Program, Lewis Field would manage Orion Service Module and Spacecraft Adapter development and provide Ares Upper Stage support and development. PBS would provide Orion acoustic/random vibration, thermal vacuum, and electromagnetic compatibility/interference testing and Ares Upper Stage engine testing and integrated stages testing.

ES.6.1.7 Langley Research Center

NASA's LaRC is located on a coastal plain in the northeastern portion of the city of Hampton, Virginia. LaRC occupies 327 ha (808 ac) of land adjacent to the Langley Air Force Base. LaRC performs research in airframe systems and atmospheric sciences. For the Constellation Program, LaRC would manage Orion Launch Abort System development, the Orion landing system development and testing, and Ares ascent development flight test vehicle integration.

ES.6.1.8 Ames Research Center

NASA's ARC encompasses approximately 800 ha (2,000 ac) in the northern portion of Santa Clara County, California. ARC primarily engages in the areas of information technology,

nanotechnology, fundamental space biology, biotechnology, aerospace and thermal protection systems, and human factors research. For the Constellation Program, ARC would lead Orion Thermal Protection System development.

ES.6.1.9 White Sands Missile Range/Johnson Space Center White Sands Test Facility

WSMR is a multi-service facility managed by the U.S. Department of the Army to support research, development, testing, and evaluation of weapons and space systems. WSMR provides a variety of services to governmental agencies, approved commercial firms, and foreign governments. NASA's WSTF operates under JSC as a field test installation within the boundaries of WSMR with the primary purpose of providing test services to NASA for the U.S. Space Program. For the Constellation Program, WSMR would perform Orion abort flight test ground operations, launch pad abort testing, and flight ascent abort testing. During vehicle development and testing, WSTF would perform ground servicing and operational checkout of the Orion Launch Abort System flight tests. These tests would be coordinated with WSMR Range Safety. WSTF also would perform Ares Upper Stage hot fire engine verification testing of the Reaction Control System and Thrust Vector Control subsystems.

ES.6.1.10 Other U.S. Government Facilities

Other U.S. Government facilities that would support the Constellation Program include NASA's DFRC, GSFC, and JPL. Most of the activities that would be implemented at these facilities would be limited to engineering design and data analysis, project management, procurement, operational checkout, component testing, and administrative support, and would fall within the normal realm of operations at each facility. The Constellation Program also may use other U.S. Government facilities, such as the U.S. Air Force's wind tunnels and other test facilities.

ES.6.2 Commercial Facilities

ES.6.2.1 Alliant Techsystems-Launch Systems

Activities associated with the Constellation Program would occur at two ATK locations in Utah, including ATK-owned facilities at Promontory, which is northwest of Brigham City, Utah, and at leased facilities at the Clearfield Refurbishment Center, which is southwest of Ogden, Utah. ATK provides manufacturing and testing services for rocket motor systems used in space launch vehicles, strategic missiles, and other missile systems. For the Constellation Program, ATK would provide solid rocket motor development, testing, and production for the Ares launch vehicles. ATK may perform additional work for the Constellation Program awarded through competitive procurements.

ES.6.2.2 Other Commercial Facilities

The Constellation Program would be supported by various other commercial facilities throughout the U.S. It is expected that the activities engaged in at each commercial facility involved in the Constellation Program would fall within the normal realm of operations at that facility. It is also expected that all such facilities would be in compliance with applicable Federal, state, and local environmental laws, regulations, and permits. NASA would ensure that

this is the case as a matter of contract with all commercial entities selected to support the Constellation Program.

ES.6.3 Global Environment

In accordance with EO 12114, *Environmental Effects Abroad of Major Federal Actions*, this Final PEIS provides a general overview of the global environment. It includes basic descriptions of the troposphere, stratosphere, and potential landing sites for the Orion Crew Module and jettisoned Orion and Ares hardware.

The troposphere is the atmospheric layer closest to the Earth's surface. This layer accounts for more than 80 percent of the mass and essentially all of the water vapor, clouds, and precipitation contained in the Earth's atmosphere. The height of the troposphere ranges from an altitude of 10 km (6 mi) at the poles to 15 km (9 mi) at the equator. In general, the troposphere is well-mixed and aerosols in the troposphere are removed in a short period of time as a result of this mixing and scavenging by precipitation. A narrow region called the tropopause separates the troposphere from the stratosphere.

The stratosphere extends from the tropopause to an altitude of approximately 50 km (31 mi). In general, vertical mixing is limited within the stratosphere, providing little transport between the layers above and below. Thus, the relatively dry, ozone-rich stratospheric air does not easily mix with the lower, moist, ozone-poor tropospheric air. The lack of vertical mixing and exchange between atmospheric layers provides for extremely long residence times, on the order of months, causing the stratosphere to act as a reservoir for certain types of atmospheric pollution. The Montreal Protocol, an international treaty ratified by the U.S., is designed to protect the stratospheric ozone layer by phasing out production and consumption of substances that deplete the ozone layer. It was first adopted in 1987 with additional revisions adopted through 1999. Recent measurements indicate that stratospheric chlorine levels are decreasing, consistent with expected declines resulting from the Montreal Protocol.

Although both ocean and terrestrial landing sites for the return of the Orion Crew Module are currently under study, terrestrial landing sites are not addressed in this Final PEIS. In general, it is expected the terrestrial landing site(s) would be in the western continental U.S. and would consist of the following characteristics: a sparsely populated large, flat area of land without marshes, forests, boulders, or ravines. At such time as the evaluations of terrestrial landing sites mature sufficiently, NASA will prepare separate NEPA documentation, as appropriate.

An ocean landing of the Orion Crew Module could occur in the Atlantic Ocean, Indian Ocean, or Pacific Ocean following a launch ascent abort, or in the Pacific Ocean off the western coast of the U.S. following a normal Earth atmospheric entry from the International Space Station or the Moon. A recovery team would retrieve the Orion Crew Module upon Earth return. Although specific atmospheric entry landing locations are unknown at this time, the future selection process would avoid sensitive marine environments to the extent possible.

The primary hardware that would be jettisoned during an Orion/Ares I launch would include the Ares I First Stage and Upper Stage, the Orion Launch Abort System, and the Spacecraft Adapter fairings. For an Ares V launch, the primary hardware that would be jettisoned would include the

Core Stage, payload fairings, and SRBs. Similar components would be jettisoned during Ares test launches at KSC. These components would fall into either the Indian Ocean or the Atlantic Ocean, depending upon when each is jettisoned during launch vehicle ascent. In addition, the Orion Service Module and docking mechanism (for International Space Station missions) would be jettisoned into the Pacific Ocean during atmospheric entry. Components could also be jettisoned into the Indian, Atlantic, or Pacific Ocean in the event of a launch ascent abort; however, the possibility exists that hardware components could fall on land. Under a normal launch, a recovery team would retrieve the Ares I First Stage and the Ares V SRBs. While all remaining hardware would not be recovered and would be expected to breakup in the atmosphere or upon ocean impact and sink to the ocean floor, some hardware components may remain temporarily afloat.

The Constellation Program is studying the possibility of not recovering the spent Ares I First Stage and Ares V SRBs for certain missions. This could gain additional performance margin for certain missions by eliminating the launch weight of the booster recovery systems.

ES.7 ENVIRONMENTAL CONSEQUENCES

ES.7.1 Proposed Action

ES.7.1.1 U.S. Government Facilities

ES.7.1.1.1 John F. Kennedy Space Center

Activities associated with launch operations for the Ares launch vehicles, including post-launch cleanup and rehabilitation of the launch platform and associated facilities, would be the primary source of environmental impacts from the Constellation Program at KSC.

Environmental impacts associated with Ares launches from LC-39 would be similar to those that are normally experienced with Space Shuttle launches. Space Shuttle launch impacts are principally associated with the hydrogen chloride (HCl) emissions in the exhaust cloud created from ignition of the Space Shuttle's SRBs at liftoff. The interaction of the SRB emissions with deluge water from the launch pad's sound suppression system creates a wet acidic deposition that produces local environmental impacts near the launch complex, including vegetation spotting, and temporary increase of acidity in the shallow surface waters near LC-39 Pads A and B, resulting in fish kills of up to several hundred individual fish. These periodic events do not appear to have had a long-term adverse effect on fish populations in these shallow waters. Differences in local environmental effects could result if the amount and use of water for sound suppression at liftoff differed for Ares launches. Because less solid propellant would be used for the Ares I launch vehicle than the Space Shuttle, the near-field impacts for this vehicle (within 500 m [1,640 ft] to 1,000 m [3,281 ft] of the launch pad) would be expected to be smaller than those from Space Shuttle launches. The near-field impacts from the Ares V launch vehicle would be expected to be similar to those resulting from Space Shuttle launches. The far-field impacts (more than a few kilometers from the launch pad) of Ares I and Ares V launches would be expected to be negligible, similar to those from the Space Shuttle. When launches are planned, Launch Range Safety uses models and launch safety criteria to ensure that measurable far-field effects do not occur.

Space Shuttle launches also typically result in a temporary startle response from nearby birds and other wildlife. Protected species such as bald eagles, Florida scrub jays, and wood storks near the launch complex do not appear to have sustained any long-term adverse impacts from the periodic Space Shuttle launches. It is anticipated that no protected species, critical habitats, or wetlands would be adversely impacted by Ares launches.

Noise modeling for the Ares V was performed using a bounding launch configuration with a total thrust of about 54.7 million Newton (N) (12.3 million pounds [lb]) rather than the current planning configuration thrust of about 44 million N (10 million lb). A bounding launch configuration was used to consider potential variations in future engine designs and configurations. Preliminary calculations indicate that sound levels for an Ares V launch with a bounding launch vehicle configuration would reach approximately 78 to 82 A-weighted decibels (dBA) at the city of Titusville for a short period. The predicted noise levels at the KSC Visitor Center and KSC Industrial Area would be 88 and 92 dBA, respectively. At 4.8 km (3 mi) away from the launch pad (the approximate distance to the Vehicle Assembly Building [VAB]), Ares V noise levels would be in the range of 99 to 102 dBA. Most KSC employees would be stationed beyond this distance. Noise levels of about 98 dBA would occur at the Saturn V viewing site. These values are comparable to, but likely to be a few dBA (1 to 2) higher than, those of Space Shuttle and past Saturn V (Apollo era) launches. Ares I launch noise levels are predicted to be approximately 5 to 9 decibels (dB) lower at each of these locations. As with other launches, the noise generated by Ares I and Ares V launch vehicles would last only for a very short duration (approximately 20 to 30 seconds). Human exposure to Ares V noise levels at a 75 dBA level for 30-seconds would be much lower than the Occupational Safety and Health Administration (OSHA) recommended maximum 8-hour exposure limit of 85 dBA. Exposure to short-term launch noise levels of 75 to 90 dBA would not be expected to result in effects among the public other than minor, short-term discomfort.

The potential impact of Ares I launch noise on structures would be expected to be minimal, since these noise levels should be lower than those experienced with Space Shuttle launches. The potential noise and vibration levels associated with Ares V launches would likely be comparable to past Space Shuttle and Saturn V launches; therefore, the potential exists for minor localized damage to windows (onsite and offsite) and other sensitive building elements. In the event of private property damage, NASA has procedures in place to evaluate such damage and provide for compensation, if warranted.

Sonic booms would occur over the open ocean during launch of an Ares I and Ares V, and when jettisoned components reenter the atmosphere. These sonic booms would be similar to those associated with Space Shuttle launches and would be expected to be minor.

NASA implements a Range Safety policy to protect the public against launch accidents. NASA's policy is designed to protect the public, employees, and high-value property and is focused on the understanding and mitigation (as appropriate) of risk. Potential impacts from catastrophic incidents involving launch vehicles are assessed as part of the overall Range Safety evaluation.

Impacts in the KSC area associated with launch accidents would be limited to those accidents which occur in the early ascent phase of a mission since the Ares launch vehicles would fly

northeastwardly away from the launch pad over the Atlantic Ocean. The most significant potential health hazard from an Ares I or Ares V launch accident outside the immediate vicinity of the launch pad would be the HCl emitted from burning solid propellant. Launch Range Safety uses models to predict launch hazards to the public and onsite personnel prior to every launch. These models calculate the risk of casualty resulting from HCl, debris, and blast overpressure during potential launch failures after accounting for local meteorological conditions. Launches may be postponed if the predicted collective public risk of injury exceeds approved levels (they may also be allowed to continue, given approval from the NASA Procedural Requirements [NPR] 8715.5 “Range Safety Program” designated authority, depending on the specific hazards posed and risk levels on the day of launch). This approach takes into account the probability of a catastrophic failure; the resultant hazard distributions for the principal Range Safety hazards (toxics, debris, and blast overpressure); and emergency preparedness procedures.

It is expected that minor upgrades and modifications to historic ground processing and launch facilities currently being used for the Space Shuttle Program and International Space Station activities would occur at KSC. While most of these modifications would be minor and have little or no effect on the use or status of the properties, some would be major and constitute an adverse effect as defined in 36 CFR 800.5, *Protection of Historic Properties*. Some impacts identified to date include: the removal of the Fixed and Rotating Service Structures from LC-39 Pad B and potentially from LC-39 Pad A; modifications to the Firing Rooms in the Launch Control Center; and modifications to the Orbiter Processing Facility to accommodate Ares V Upper Stage or lunar payload processing. Additional adverse effects to other historic properties may be identified as the program matures. Mitigation activities would be developed in coordination with the State Historic Preservation Officer.

ES.7.1.1.2 John C. Stennis Space Center

At SSC, the principal environmental impacts would be associated with noise from testing of Ares J-2X Upper Stage and Ares V RS-68B Core Stage liquid fueled rocket engines. Individual RS-68B engines from the Ares V would be tested, as well as a cluster of five RS-68B engines that would collectively serve as the Ares V main engine in the current planning configuration.

Under the Proposed Action, full-scale liquid rocket engine testing at SSC would occur at either the B-1/B-2, A-1, or A-2 test stands. These test stands are located in the central portion of SSC and oriented in a manner that direct sound to the north and east. Because the propellants used in the Ares Upper Stage and the Ares V Core Stage would be liquid oxygen and liquid hydrogen, the principal air emission from engine testing would be water vapor. Thus, testing would not be expected to adversely impact air quality at SSC or in surrounding communities.

NASA is planning to operate a new test stand (A-3) (currently under construction) to test J-2X engines in a vacuum, simulating high altitude conditions (approximately 30,480 m [100,000 ft]). The high-altitude (vacuum) conditions would be simulated through the use of chemical steam generators that would use isopropyl alcohol, liquid oxygen, and water to reduce the pressure in the test cell and downstream of the engine. The environmental impacts of this new test stand are evaluated in more detail in the *Final Environmental Assessment for Construction and Operation of the Constellation Program A-3 Test Stand, Stennis Space Center, Hancock County, Mississippi*. In planning mitigation activities associated with development of the new A-3 Test

Stand for the Constellation Program, SSC has delineated 47.9 hectares (118.54 acres) of wetlands credits which would be charged against its “Mitigation Bank”, managed by the U.S. Army Corps of Engineers.

NASA operations at SSC are considered to be a “major source” of air emissions as defined by the Clean Air Act and the addition of the A-3 Test Stand require modifications to the existing air permits. Since the proposed carbon monoxide (CO) emissions from the A-3 Test Stand at the projected peak test schedule of two tests per month would exceed the EPA’s Prevention of Significant Deterioration annual significant emission increment threshold of 100 tons per year, SSC would model the impacts to supplement the Prevention of Significant Deterioration permit application to show that the increased emissions would not have a significant effect on air quality.

A perpetual restrictive easement of 506 square km (195 square mi) extends 9.7 km (6 mi) in all directions from SSC and acts as a buffer zone. The purpose of the buffer zone is to provide an acoustical and safety protection zone for NASA testing operations. Noise from Constellation Program engine tests at SSC would generally be similar to ongoing tests of Space Shuttle main engines and Delta IV RS-68 engines. Only the tests of the RS-68B cluster for the Ares V Core Stage would potentially produce noise levels that exceed ongoing test activities. The RS-68B cluster test noise levels would be expected to be similar to those experienced during Saturn V main engine testing and could result in similar noise impacts and complaints. During the Saturn V rocket-testing program between 1966 and 1970, NASA logged 160 complaints, of which 57 resulted in formal administrative claims to NASA. Eighteen of the complaints resulted in financial settlements.

Maximum offsite noise levels would be less than the 77 dBA level estimated for testing the Saturn V-like main-engine cluster, which produced over twice the thrust of the Ares V cluster. These noise levels would have an insignificant human health impact due to the short duration of the individual engine tests. At the anticipated noise levels of 65 dBA (single engine) and less than 77 dBA (five-engine cluster) during Constellation Program engine tests, some interference with individual conversations during daytime would be expected. Because of the infrequency and short duration (less than 10 minutes) of each test the impact would be small.

No protected species or critical habitats have been observed in the SSC engine test area. If a protected species is identified, the U.S. Fish and Wildlife Service would be consulted and a management procedure would be put in place. NASA has consulted with the Mississippi State Historic Preservation Officer regarding modifications to the existing A and B test stands and adverse effects would be mitigated.

ES.7.1.1.3 Michoud Assembly Facility

The principal environmental impacts at MAF would be associated with the manufacture, assembly, and component testing of the Orion Crew Module and Service Module and the Ares I Upper Stage, and the possible manufacture and assembly of the Ares V Core Stage and/or the Earth Departure Stage. The proposed activities and processes that would support the Constellation Program would be expected to be similar to the normal scope of activities undertaken at MAF. Therefore, anticipated air and noise emissions would not be expected to

change substantially from current practices. No protected species, critical habitats, or wetlands would be adversely impacted. It is anticipated that minor upgrades and internal modifications to several historic facilities could occur at MAF. While most of these modifications would be minor and have little or no effect on the use or status of the properties, some could possibly be major and constitute an adverse effect and would be managed accordingly.

ES.7.1.1.4 Lyndon B. Johnson Space Center

The Constellation Program would utilize legacy Space Shuttle Program and International Space Station planning, training, and support facilities at JSC, including its two satellite facilities, Ellington Field and the Sonny Carter Training Facility. No protected species, habitat, or wetlands would be adversely impacted by the proposed Constellation Program activities at JSC. Mission operations that would be needed to support Constellation Program would be conducted in Building 30, but would not involve or pose an adverse effect on the Apollo Control Room, which is a National Historic Landmark or the Mission Control Center, which is eligible for listing in the National Register of Historic Places. Anticipated modifications to Building 30 would be limited to rewiring or other minor modifications that would not affect the historic status of either facility.

ES.7.1.1.5 George C. Marshall Space Flight Center

The principal environmental impacts at MSFC from Constellation Program activities would be associated with engine development and testing activities. Although most large engine testing would occur at other sites, some engine testing is anticipated at MSFC, such as full-scale J-2X engine testing (*e.g.*, Main Propulsion Test Article). These types of tests would be consistent with ongoing and past engine development and testing activities at MSFC. All engine test facilities are located in the southern portion of MSFC approximately 4 to 12 km (2.5 to 7 mi) from the nearest private property. Ground vibration testing of the Ares I launch stack and possibly the Ares V launch stack also would be performed at MSFC.

The air emissions generated at MSFC as a result of the Proposed Action would be limited to levels consistent with the typical types of engine testing that currently occur. The exhaust cloud from Main Propulsion Test Article testing would be principally water vapor. Detailed air emission projections for a range of engine types, including engines more powerful than those anticipated for the Constellation Program, have been modeled for MSFC. That modeling indicates that the maximum concentrations of air emissions from large-thrust engine tests would be well below regulatory standards and the Prevention of Significant Deterioration increment levels that would trigger additional evaluation and modeling.

The noise impacts of engine testing at MSFC have been extensively evaluated. Noise modeling has indicated that for a small-thrust engine such as the Space Shuttle main engine, the maximum sound pressure at the closest private property to MSFC test sites would be 107 dB. The predicted maximum offsite A-weighted sound levels would be approximately 94 dBA. These noise levels would be very noticeable locally but would not have health impacts because of their short duration (less than seven minutes per test). People are exposed to similar noise levels from traffic, aircraft, and other normal daily activities. These noise levels would not cause significant

damage to structures. This is consistent with what has been historically observed in the nearby communities with past MSFC engine tests.

Maximum off-site noise levels of 94 dBA for up to seven minutes would be lower than the 100 dBA two-hour exposure threshold at which OSHA requires a hearing conservation program (29 CFR 1910.95). Therefore, no hearing effects among the general public would be projected. The impacts of noise from MSFC engine tests are mitigated by the physical separation of the test facilities from the general public. MSFC is surrounded by a large federally-owned area consisting of the Redstone Arsenal and the Wheeler National Wildlife Refuge.

A new spray-on foam insulation spray booth would be constructed in one or more existing MSFC buildings to support Ares Thermal Protection System development. This activity would potentially require modification to the existing CAA Title V air permit. There are currently no additional plans for new facility construction at MSFC. However, rehabilitation of existing facilities associated with Constellation Program activities would be anticipated.

ES.7.1.1.6 John H. Glenn Research Center – Lewis Field and Plum Brook Station

Air emissions generated as a result of the Proposed Action at GRC Lewis Field and PBS would likely be comparable to emissions from ongoing activities at each site. Constellation Program activities at GRC Lewis Field would not be expected to adversely impact biological resources at the site. It is not anticipated that Constellation Program activities at PBS would adversely impact any protected species or special management areas.

Testing of the J-2X engine at PBS would require modifications to the B-2 Vacuum Facility, which is part of the Spacecraft Propulsion Research Facility (Building 3211), a National Historic Landmark. The modifications would be considered an adverse effect and would therefore have to be managed in consultation with the Ohio State Historic Preservation Officer. In addition, the Space Power Facility (Building 1411) at PBS, a National Register of Historic Places-eligible facility, would undergo some modifications to accommodate integrated environmental qualification testing of the Orion spacecraft; however, no adverse effects would be expected.

ES.7.1.1.7 Langley Research Center

Air emissions from the activities anticipated under the Proposed Action at LaRC would likely be comparable to emissions from ongoing activities at the site. Constellation Program activities at LaRC would not be expected to adversely impact surface water or groundwater resources, protected species, habitat, or wetlands.

Several historic properties at LaRC may be modified to support Constellation Program activities; however, it is expected that most of these modifications would be minor and have little or no effect on the properties. Specifically, use of the Impact Dynamics Facility (Gantry) (Building 1297), a National Historic Landmark, for drop testing the Crew Module, may require refurbishing or modification. NASA has consulted with the Virginia State Historic Preservation Officer, who concurred with the proposed mitigation, indicating there would be no adverse effect to the Gantry from the proposed modifications.

ES.7.1.1.8 Ames Research Center

The reasonably foreseeable Constellation Program activities proposed for ARC would be very similar to ongoing activities conducted in support of the Space Shuttle Program. No adverse environmental impacts would be anticipated.

ES.7.1.1.9 White Sands Missile Range/Johnson Space Center White Sands Test Facility, Las Cruces, New Mexico

Orion Launch Abort System testing would constitute the principal source of environmental impacts from the Constellation Program at WSMR/WSTF. NASA has prepared the *Final Environmental Assessment for NASA Launch Abort System (LAS) Test Program, NASA Johnson Space Center White Sands Test Facility, Las Cruces, New Mexico* to evaluate the potential impacts of both construction and facility modifications necessary to support the proposed tests and the potential impacts of the tests. All Launch Abort System testing activities would occur within the boundaries of WSMR. No protected species or critical habitats are anticipated to be impacted. Any modifications to historic properties would be performed in consultation with the New Mexico State Historic Preservation Officer.

ES.7.1.1.10 Other U.S. Government Facilities

Constellation Program activities associated with DFRC, GSFC, and JPL would be focused primarily on, but not be limited to, project management, engineering and data analysis, and procurement and administrative support. Only limited physical testing, fabrication, or assembly of Constellation Program components would be expected to be performed at these facilities. Activities at other U.S. Government facilities, such as the U.S. Air Force's wind tunnels and other test facilities, would be expected to be within the normal realm of operations at each facility. Therefore, little or no impacts to land resources, air resources, water resources, noise, geology or soils, biological resources, socioeconomics, historical or cultural resources, transportation, or environmental justice would be anticipated. Any future construction of new buildings or major modifications needed to support future Constellation Program activities at these facilities would be subject to separate NEPA review and documentation, as appropriate.

ES.7.1.2 Commercial Facilities

ES.7.1.2.1 Alliant Techsystems-Launch Systems, Utah

Air emissions from solid rocket motor tests and manufacturing accidents are the primary environmental impact concerns at ATK's Promontory facility. The Clearfield Refurbishment Center (CRC) is used to refurbish solid rocket motor casings for the Space Shuttle. Air emissions associated with solid rocket motor refurbishment are the principal environmental impact concerns at CRC.

The design for the Ares I First Stage and Ares V SRBs assumes the continued use of 1,1,1-trichloroethane (TCA), a banned substance under the Montreal Protocol. NASA and ATK have an Environmental Protection Agency (EPA) exemption allowing the use of remaining

stockpiled TCA as an essential use item for the U.S. Space Program. This stockpile is adequate to support solid rocket motor production through 2020.

The Space Shuttle Program also holds an exemption from the EPA that allows the use of hydrochlorofluorocarbon (HCFC 141b) for critical Space Shuttle manufacturing operations. HCFC 141b is used as a blowing agent to produce foam plugs for solid rocket motor nozzles. Small quantities of HCFC 141b are used to fill test holes in foam insulation on the exterior surface of Space Shuttle solid rocket motors. It is expected that the Constellation Program would not use HCFC 141b for launch vehicles as NASA intends to develop cryoinsulation material without HCFC 141b. However, NASA may use small amounts of HCFC 141b for comparative studies when developing alternate materials.

Air quality analyses have indicated the primary emissions of concern from limited ground test firings of solid rocket motors and initial testing of the Ares solid rocket motors at the Promontory facility (HCl, NO_x, and particulate matter) have been well below Federal and Utah regulatory limits. The Promontory facility is in an attainment area and operates under a Clean Air Act Title V permit, which provides for ground firings of solid rocket motors.

Noise levels from past solid rocket motor test firings have been well below levels of concern in public areas. The Proposed Action would not result in any new types of noise sources introduced into either the CRC or Promontory areas.

ES.7.1.2.2 Other Commercial Facilities

Facilities owned or operated by other commercial entities would be utilized for the Constellation Program. While many of these facilities would be engaged in other aerospace activities, the Constellation Program would be a part of ongoing operations. Each facility also would have to comply with applicable Federal, state, and local environmental laws, rules, and regulations.

ES.7.1.3 Other Potential Impacts

ES.7.1.3.1 Ocean Impacts of Launch Vehicle Components

The Proposed Action would result in an ocean splashdown of components jettisoned during the ascent phase of the crewed launches from KSC. These components include the Ares I First Stage and Upper Stage with the Service Module adapter and shrouds, Launch Abort System, and, for lunar missions, the Ares V Core Stage, payload shrouds, SRBs, and other minor hardware. Only the Ares I First Stage and Ares V SRBs would be expected to be recovered. However, The Constellation Program is studying the possibility of not recovering the spent Ares I First Stage and Ares V SRBs for certain missions. Similar components would be jettisoned to the ocean from uncrewed KSC test launches. Many aspects of the launch profile and recovery/disposal operations would be similar to those currently used for the Space Shuttle Program.

A residual amount of hydraulic fluid and hypergolic propellants would remain in the launch vehicle stages when they fall into the ocean. If released, the fluid and propellants would be diluted by seawater and would not be expected to affect marine species. Some soluble products

from the Launch Abort System and residual Ares I First Stage and Ares V SRB fuel introduced into the ocean environment would be expected to produce short-term localized impacts.

NASA would ensure timely Notices to Airmen (NOTAM) and Notices to Mariners would be disseminated prior to each launch.

ES.7.1.3.2 Ocean Recovery of the Ares I First Stage and Ares V SRBs

NASA's current procedures for retrieval of expended Space Shuttle SRBs would be expected to be followed during recovery of Ares I First Stage and the Ares V SRBs. Environmental impacts from the jettisoned Ares I First Stage and, for lunar missions, the Ares V SRBs and subsequent recovery and transit back to KSC would be anticipated to be minimal. The splashdown zones would be in the open ocean, which is less biologically rich than upwelling and coastal areas and where the probability of striking marine mammals would be highly unlikely.

Vehicle elements not recovered, while not totally inert, would dissolve slowly, dissipate, and become buried in the ocean bottom. Some components could remain temporarily afloat. Corrosion of stage hardware would contribute various metal ions to the water column; however, due to the slow rate of corrosion in the deep ocean environment and the quantity of water available for dilution, toxic concentrations of metals are not likely to occur. Because of the limited number of launch events scheduled and the very large volume of water available for dilution, no adverse impacts would be expected from the nonfuel materials associated with the jettisoned launch vehicle stages.

Launch Range Safety would ensure that the risks to ships, aircraft, and personnel in the splashdown zone would be managed according to NPR 8715.5 "Range Safety Program."

ES.7.1.3.3 Service Module and Docking Mechanism Jettison and Crew Module Landing in the Pacific Ocean

The Orion Service Module (and docking mechanism for International Space Station missions) would be jettisoned prior to atmospheric entry. These components would breakup and fall as debris into a targeted area of the Pacific Ocean. Potential environmental impacts associated with the resulting debris field would be expected to be small. Activities most likely to be affected would be trans-ocean surface shipping and airline routes. No impacts with aircraft or ships would be anticipated as NOTAMs and Notices to Mariners would be disseminated well in advance. It is anticipated that the probability of striking marine mammals within the debris field would be small due to the large footprint of the area relative to the amount of debris and the open ocean being less biologically rich than upwelling and coastal areas. JSC Range Safety would ensure that the risks to ships, aircraft, and personnel in the splashdown zone would be managed according to NPR 8715.5 "Range Safety Program."

It is expected that most components would sink and slowly corrode on the ocean floor; however, some components could remain temporarily afloat. Toxic concentrations of metals would be unlikely because of slow corrosion rates and the volume of seawater available for dilution. Propellant in the Service Module would be expected to vent fully prior to debris impact. Trace

amounts of propellant could remain which would be expected to have a negligible environmental impact.

The return of the Orion spacecraft would result in a sonic boom, the magnitude of which would be expected to remain below the magnitude of sonic booms from Space Shuttle atmospheric entries. The impacts from the sonic boom would be expected to be minor.

Ocean landing and recovery of the Crew Module would be similar for both International Space Station and lunar mission returns. Environmental impacts associated with ship operations supporting the recovery of the Crew Module would be typical of ongoing U.S. Navy sea and port operations. Residual fuel (methane/oxygen bipropellant) would remain in the Crew Module and would be properly managed during recovery operations to minimize the potential for spilling into the ocean. The Constellation Program is currently studying the possibility of substituting the methane/oxygen bipropellant with a monopropellant (*e.g.*, hydrazine).

ES.7.1.3.4 Terrestrial Landing and Recovery of the Crew Module

Landing and recovery of the Crew Module at a terrestrial location(s) in the continental U.S. is presently under evaluation and would be the subject of separate NEPA review and documentation, as appropriate. NASA would manage entry Range Safety according to NPR 8715.5 "Range Safety Program."

ES.7.1.3.5 Transportation of the Ares I First Stage and Ares V SRBs

The primary Constellation Program terrestrial transportation hazards would be the same as for the Space Shuttle Program (*i.e.*, accidents during railcar transport of fueled solid rocket motors). Solid rocket motors could ignite and burn under potential railcar accident conditions. Ignition could be caused by high temperature, static discharge, or mechanical impact. These could occur during a transportation accident caused by a collision or train derailment, vandalism, or sabotage. Depending on location and surrounding conditions, such an event could potentially have serious consequences. Direct damage from one or more solid rocket motors burning accompanied by potentially induced secondary fires or explosions, could clearly be greater in urban or developed areas.

Current practice for transporting fueled solid rocket motors from ATK to KSC for the Space Shuttle Program is via rail on specially designed rail cars with on-board ATK personnel. It is anticipated that the Constellation Program would adopt the same protocols for transporting solid rocket motors. Rail transportation has been used approximately 300 times to transport fueled Space Shuttle motor segments from Utah to KSC. Each of these has been followed with a return trip, and in about 10 instances return trips have carried fueled solid rocket motor segments. Each of these shipments was conducted safely with no instances of accidental ignition. These shipments comply with all applicable Department of Transportation regulations for rail shipment of hazardous materials. As such, minor rail incidents, such as train derailments, have not resulted in ignition of the solid propellant.

On May 2, 2007, a train transporting Space Shuttle solid rocket motors and a passenger car with technicians on board to monitor their transportation derailed near Linden, Alabama when a

railroad bridge (trestle) collapsed under the locomotives. Six people were injured when the two locomotives and the passenger car dropped about 3 m (10 ft) and turned on their sides. One of the railcars carrying solid rocket motor segments also fell on its side and three other railcars and segments experienced a jarring drop. The four other railcars containing segments remained upright and undamaged. As was expected with the safety precautions taken with each shipment, the incident did not result in ignition of the solid propellant.

ES.7.1.4 Global Environment

Cumulative global impacts on stratospheric ozone depletion from Ares launches have been considered in this Final PEIS. Over the 2009 to 2014 timeframe, seven Ares I test launches are planned and up to five Ares I mission launches per year are planned between 2015 to 2020, although the actual number of launches could be lower. In addition, five Ares V launches are planned between 2018 and 2020. Assuming a direct relationship between stratospheric releases of ozone-depleting substances from launch vehicles and annually averaged global ozone level changes, the expected annually averaged global ozone level reductions from Constellation Program stratospheric HCl and Al₂O₃ releases would be no more than 0.0038 percent and 0.0014 percent, respectively, or a total of 0.0051 percent over that period.

The principal source of global warming emissions associated with the Constellation Program would be from NASA's energy use in support of the Program. NASA consumes energy primarily across four end-use sectors: 1) standard buildings; 2) industrial, laboratory, and other energy intensive facilities; 3) exempt facilities; and 4) vehicles and equipment, including aircraft operations. Between fiscal year 1990 and 2005, NASA reduced its total primary energy use by 14 percent. It is NASA's policy to fully comply with the requirements of the National Energy Conservation Policy Act, EO 13423, *Strengthening Federal Environmental, Energy, and Transportation Management*, and other statutory and Presidential directives regarding energy efficiency.

Ares engine testing, Launch Abort System testing, and launches over the 2009 to 2020 timeframe resulting in emissions of water vapor, CO, and CO₂, and potentially the continued use of HCFC 141b in foam blowing, would constitute the other principal sources of Constellation Program emissions with the potential of affecting global warming. Although water vapor is considered a greenhouse gas, it is not tracked in the U.S. inventory. The Constellation Program's cumulative contribution to global warming from CO₂ and CO rocket exhaust emissions would be expected to be much smaller than NASA's contribution from energy consumption.

Under the Proposed Action, it has been assumed that HCFC 141b would not be used to produce foam insulation for the liquid hydrogen/liquid oxygen tanks for the Ares I and Ares V vehicles. To comply with EPA requirements to phase out Ozone Depleting Substances (ODS), and to reduce the long-term supportability risk posed by ODS usage, NASA intends to develop cryoinsulation replacements for the Ares I Upper Stage that do not contain HCFC 141b. NASA may continue to employ relatively small amounts of HCFC 141b foam for use in comparative studies.

Collectively, the total global warming potential from NASA's Constellation Program activities (rocket emissions, rocket testing, and foam blowing) and NASA's primary energy use over the 2009 to 2020 time period is estimated to be less than 0.004 percent of that from all annual U.S. carbon emissions over that period.

ES.7.2 No Action Alternative

Under the No Action Alternative, the environmental impacts associated with implementing the Proposed Action would not occur. Specifically, no direct impacts associated with launch vehicle engine tests, launches, wind tunnel tests, construction of new facilities and modifications of existing facilities, and other direct actions connected with human spaceflight would occur. This would result in less noise and contamination of the air, water, and soil in the near term. In addition, the secondary impacts associated with the workforce supporting the Proposed Action would not occur. These impacts relate to the support infrastructure (*e.g.*, structures, utilities and roads) and include waste, water impacts, noise and air emissions, as well as the socioeconomic impacts of the workforce on the surrounding communities and region.

At this time, a prediction cannot be made as to how the President or Congress would redirect funding and personnel that would otherwise support the proposed Constellation Program. As indicated earlier, the President has directed NASA to close-out the Space Shuttle Program no later than 2010. Without new programs and projects to fill the void left by the close-out of the Space Shuttle Program, substantial adverse socioeconomic impacts would be experienced by localities that host NASA Centers heavily involved in the Space Shuttle Program.

ES.7.3 Cumulative Impacts

The proposed Constellation Program would largely be built upon the ongoing Space Shuttle Program's technologies and facilities. Therefore, at each of the potential sites that would have both Space Shuttle Program and Constellation Program-related activities, the potential environmental impacts would be either very small when compared to past, ongoing, or future activities, or would be very similar to the current impacts associated with the Space Shuttle Program. For most of the sites, the proposed activities under the Proposed Action would be expected to initially overlap with the Space Shuttle Program until the Space Shuttle fleet is retired. As a result, the broad incremental impacts of the Proposed Action above those that have been or are currently being felt would generally be small, but could be larger at sites that have minimal ongoing Space Shuttle Program work.

Each NASA Center has multiple on-going programs that would be managed concurrently with the Constellation Program. It is reasonable to expect that these programs would conduct testing and evaluation activities and could engage in the construction or modification of buildings as needed. In addition, each NASA Center has funding plans which identify activities such as construction, demolition, or rehabilitation of buildings and test stands. Such activities would be evaluated for environmental impacts by the sponsoring program or affected Center(s) and would be subject to separate NEPA review and documentation, as appropriate. However, these activities may or may not occur within the given timeframe of the funding plan due to many factors (*e.g.*, implemented funding and program direction) and may or may not have any environmental impacts. NASA has identified categories of actions that have demonstrated no impact to the

environment when implemented. In general, many on-going activities at NASA Centers fall into these categories of actions. For purposes of the cumulative impacts analysis, those Center activities that have no environmental impact are not discussed in detail in this Final PEIS.

ES.7.4 Incomplete or Unavailable Information

The Constellation Program is in the early design stages; therefore, it is reasonable to expect that there would be changes to the Program's plans and designs if the Proposed Action is selected. The changes could include modification to the Orion spacecraft and the Ares launch vehicles; the locations where development and testing would occur as well as their timing; and/or a reduction in the number of launches from the planned baseline.

The fundamental aspects of the Constellation Program that would potentially result in environmental impacts are not expected to change. Launches would be anticipated to occur from KSC and would likely rely on one or more SRBs for liftoff. The direct impacts of launch, including noise levels and exhaust cloud effects, would likely remain similar.

Several key aspects of the Constellation Program are not sufficiently defined to be thoroughly evaluated in this Final PEIS. These include:

- Potential building modifications or new construction at MAF, if MAF is chosen as the facility for Ares V Core Stage and/or Earth Departure Stage development
- Configuration of a potential new launch vehicle Vertical Integration Facility at KSC
- A new Launch Complex and new Launch Pad at KSC
- A new Crawlerway from the Vertical Assembly Building to LC-39 and new Crawler-Transport at KSC
- Addition of a new building at KSC to process hazardous materials for the Constellation Program
- Extent to which qualified commercial suppliers would be utilized to provide crew and cargo service to and from the International Space Station
- Potential building modifications at ARC in support of Orion Thermal Protection System tests
- Potential Orion Thermal Protection System flight tests
- Need for and magnitude of continued use of ozone depleting substances now used by the Space Shuttle Program, such as HCFC 141b foam
- Candidate Orion terrestrial landing sites
- Development of Lunar Landers, Lunar Surface Systems, Mar Systems, and other future systems to be implemented beyond 2020.

Detailed analysis of the socioeconomic impacts of implementing the Constellation Program cannot be performed at this time as most of the prime contract procurements are not completed. Furthermore, complete and accurate socioeconomic information, including budgetary data, workforce projections, and future procurement actions in addition to prime contract

procurements are not available thus limiting the ability to quantify the socioeconomic impact of the Constellation Program.

ES.7.5 Mitigation Measures

Activities associated with the Proposed Action that would be expected to have potential environmental impacts include rocket engine tests, rocket launches and Earth atmospheric entries, wind tunnel tests, and construction of new facilities. NASA would employ mitigation measures to avoid or reduce the magnitude of environmental impacts from Constellation Program activities, as appropriate. NASA also would continue the good environmental practices already being employed at each of the NASA facilities supporting the Constellation Program. Many of these mitigation measures and good environmental practices would be much like those currently being employed for the Space Shuttle Program.

Examples of mitigation activities and ongoing environmental practices that would contribute to mitigation of potential Constellation Program environmental impacts include:

- Range Safety policies and procedures employed at launch sites (KSC and WSMR) which are designed to protect the public, employees, and high-value property
- Notices to Airmen (NOTAM) and Notices to Mariners preceding Ares launches and Earth atmospheric entry of the Orion spacecraft to prevent collisions with surface ships and aircraft
- Mitigation of bird and bat strikes resulting from modifications to LC-39 Pads A and B at KSC (*e.g.*, minimize lightning tower height, use of minimum number of low intensity lights, use of large diameter stainless steel grounding wires) and at the launch complex used for the Launch Abort System tests at WSMR (*e.g.*, use of minimum number of low intensity lights and surveys of tower during nesting season)
- Compliance with the KSC lighting plan during construction, modification, and operation of LC-39 Pads A and B to protect nesting sea turtles
- The perpetual restrictive easement at SSC (the “Buffer Zone”) that provides an acoustical and safety protection zone for NASA testing operations
- Wetland banking at SSC to mitigate the loss of wetlands associated with construction of the new A-3 Test Stand
- The physical separation between engine test facilities at MSFC and public property provided by the U.S. Army’s Redstone Arsenal that provides an acoustical and safety protection zone for NASA testing operations
- SSC and MSFC would continue their practice of making engine test firing schedules available to the public through press releases
- SSC and MSFC would delay engine tests if substantial risk of structural damage to private property is determined to exist
- Offsite noise monitoring would be conducted at MSFC for engine tests whose thrust level meets or exceeds that of one medium engine

- Noise impacts at WSMR would be mitigated by excluding the public from areas where they could be exposed to potentially harmful noise levels and by requiring WSMR personnel to use hearing protection devices, as appropriate
- If a cultural site is discovered during excavations at WSMR, the Historic Preservation Officer would be notified for action
- WSMR also would employ dust control techniques during construction activities, vehicle controls on off-road traffic, and soil remediation for hazardous and non-hazardous waste spills.

In addition, since 1990 NASA has reduced overall annual ODS usage by more than 96 percent and is committed to finding safe and technically acceptable substitutes for remaining ODS uses. NASA intends to develop cryoinsulation replacements for use on the Ares I Upper Stage that do not contain HCFC 141b. This test program would require relatively small amounts of HCFC 141b-blown foam for use in comparative studies that would be required to ensure that replacement cryoinsulation materials have similar properties and perform at least as well as the current materials.

If the Proposed Action is implemented, a number of historic resources at various NASA facilities could be adversely affected. Modifications to historic properties could affect the character or historic integrity of such properties. NASA has a programmatic agreement with the Department of the Interior, National Park Service to mitigate impacts to National Historic Landmarks. Modifications required for the Constellation Program at NASA facilities would be undertaken in consultation with the respective State Historic Preservation Officer (SHPO). The NASA Historic Preservation Officer at each NASA facility would, in consultation with the SHPO, determine if proposed modifications would be considered “adverse” under the National Historic Preservation Act and other applicable rules and regulations. For such situations, NASA and the SHPO would develop a mitigation strategy to ensure that important historic information is preserved.